Pros and Cons of Emerging Event Data Recorders (EDRs) in the Highway Mode of Transportation

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ABSTRACT

This research cites recent efforts towards implementation of Event Data Recorder (EDR) Technologies in the United States highway mode of transportation. Initiatives of the National Transportation Safety Board (NTSB), the National Highway Traffic Safety Administration (NHTSA) are discussed, and independent research efforts are included. The findings offer IEEE professionals an opportunity to link dramatic developments in advanced telecommunication technologies to the goal of reducing injuries and deaths on the nation's highways. There has yet to be a highway safety countermeasure that has resulted in significant reductions of deaths, injuries, and crashes. Highway crashes remain the leading cause of death for children in America. Hopefully, new technologies will reduce exponentially the number of daily fatalities

In 1998, the United States had 3,192,000 motor vehicle crash injuries. EMS transported 85% of these injuries, 30% of which were admitted to a hospital.

INTRODUCTION

Between 1997 and 2001, the United States National Transportation Safety Board (NTSB) made five recommendations that set into motion research and development of Event Data Recorder (EDR) technologies. These recommendations are listed on the NTSB Most Wanted List of Transportation Safety Improvements, "a program to increase the public awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives."

NTSB MOST WANTED SAFETY LIST 2001
Automatic Information Recording Devices

Require devices that will automatically record specified information. (elements from this area also included in the Commercial Bus and Truck Safety area)

Action Needed by the Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), the Federal Aviation Administration (FAA), the Federal Railroad Administration (FRA), various trucking associations, The United States Coast Guard, and the American Public Transit Association.

HIGHWAY MODE

H-97-18 to the National Highway Traffic Safety Administration
Develop and implement, in conjunction with the domestic and international automobile manufacturers, a plan to gather better information on crash pulses and other crash parameters in actual crashes, utilizing current or augmented crash sensing and recording devices.

H-98-23 to the American Trucking Associations, International Brotherhood of Teamsters, Motor Freight Carrier Association

Advise your members to equip their commercial vehicle fleets with automated and tamperproof on-board recording devices, such as tachographs or computerized recorders, to identify information concerning both driver and vehicle operating characteristics.

H-99-19 (FHWA) (This recommendation will also be followed through the Fatigue issue area)

Establish within 2 years scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements. At a minimum, and as recommended by the National Transportation Safety Board in 1995, the revised regulations should also, (A) require sufficient rest provisions to enable drivers to obtain at least 8 continuous hours of sleep after driving for 10 hours or being on duty for 15 hours, and (B) eliminate 49 CFR 395.1 paragraph (H), which allows drivers with sleeper berth equipment to cumulate the 8 hours of off-duty time in two separate periods.

H-99-53 (NHTSA) (This recommendation will also be followed through the Automatic Recording Device issue)

Require that all school buses and motor coaches manufactured after January 1, 2003, be equipped with on-board recording systems that record vehicle parameters, including, at a minimum, lateral acceleration, longitudinal acceleration, vertical acceleration, heading, vehicle speed, engine speed, driver's seat belt status, braking input, steering input, gear selection, turn signal status (left/right), brake light status (on/off), Head/tail light status (on/off), passenger door status (open/closed), emergency door status (open/closed), hazard light status (on/off), brake system status (normal/warning), and flashing red light status (on/off) (school bus only). For those buses so equipped, the following should also be recorded: status of additional seat belts, airbag deployment criteria, airbag deployment time, and airbag deployment energy. The on-board recording system should record data at a sampling rate that is sufficient to define vehicle dynamics and should be capable of preserving data in the event of a vehicle crash or an electrical power loss. In addition, the on-board recording system should be mounted to the bus body, not the chassis, to ensure that the data necessary for defining bus body motion are recorded.

H-99-54 (NHTSA) (This recommendation will also be followed through the Automatic Recording Device issue)

Develop and implement, in cooperation with other government agencies and industry, standards for on-board recording of bus crash data that address, at a minimum, parameters to be recorded, data sampling rates, duration of recording, interface configurations, data storage format, incorporation of fleet management tools, fluid immersion survivability, impact shock survivability, crush and penetration survivability, fire survivability, independent power supply, and ability to accommodate future requirements and technological advances.

An Event Data Recorder (EDR) is an on-board device or mechanism capable of monitoring, recording, displaying, storing or transmitting pre-crash, crash, and post-crash data element parameters from a vehicle, event and driver.

The status of safety recommendations by modal administration in the Department of Transportation and the historical data covering recommendations issued between 1994 and 1998 suggest a strong indication of eventual adoption and implementation.

1994		1995		1996		1997		1998		5-year average	
Rate	# Issued	Rate	# Issued	Rate	# Issued	Rate	# Issued	Rate	# Issued	Rate	# Issued
100%	2	100%	2	92.8%	14	88.9%	10	100%	4	93.5%	32

National Highway Traffic Safety Administration (NHTSA) Acceptance Rates for Safety Recommendations Issued in the year listed.

The Problem

Automobiles have been in existence for over a hundred years (1898-2001). Today, we have over two hundred and fourteen million (214,000,000) in America alone, and over seven hundred million (700,000,000) worldwide. Nationwide, forty-seven (47,000,000) million vehicles are continually in-motion during daylight usage. Within twenty years, these numbers are expected to double. In 2000, twenty-four million (24,000,000) vehicles/occupants in the United States were involved in a crash. In the last decade, more than four hundred thousand (400,000) people died on American highways. Thirty-two million (32,000,000) were injured. The economic cost of those accidents was a trillion and a half dollars. Highway deaths are the number one killer of children in America. The National Transportation Safety Board (NTSB) reports that between 1990 and 1998, over eighty-two thousand (82,000) children under the age of twenty (20) died in motor vehicle crashes. Over fifteen thousand (15,000) of those children were under the age of ten (10), thus thirty-three (33) children under the age of ten dying every week on our highways. During the same time, over fifty-two thousand (52,000) teens between 15 and 20 died in traffic crashes- more than 110 week. Over forty thousand (40,000) people died (115 daily) and the total economic cost exceeds $150 billion annually. These statistics are unacceptable, but as a nation they seem to be accepted as the high price for our mobility. The time has come to change focus from luxury, speed, ruggedness, etc., to real safety. Instead of praising the economic benefits that the automobile industry provides the United States economy, the emphasis should be on using all available technologies in reducing crashes, injuries and deaths. The personal, social, and economic costs of motor vehicle crashes include pain and suffering; direct costs sustained by the injured persons and their insurers; indirect costs to taxpayers for health care and public assistance; and for many victims, a lower standard of living and quality of life. During the past two decades, motor vehicles accounted for over 90 percent of all transportation fatalities, and even a larger percentage of accidents and injuries. By the year 2005, the U.S. Department of Transportation projects that the annual number of crash deaths will rise to 51,000 people killed per year – despite its current safety programs. Motor-vehicle-related injury and death is the nation's largest public health problem. If the current trend continues, the first decade of this century will result in deaths and injuries affecting the equivalent of every man, woman and child now living in the states of Alaska, Arizona, Connecticut, Delaware, Washington, D.C, Hawaii, Idaho, Iowa, Kansas, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, Rhode Island, South Dakota, Utah, Vermont, West Virginia and Wyoming. The economic costs to society will approach $2 trillion. The intangible human loss will occur to family and friends of 33 million victims. Again, this loss is unacceptable. However, the increasing demand on the transportation system is negating significant gains in safety despite initiatives of the USDOT, NTSB, NHTSA, FHWA, States, Automobile Manufacturers, etc. This is occurring because people are driving more miles each year which results in congested roadways. Over the past 15 years, vehicle miles traveled has increased 35% yet new road mileage has risen a mere 1%. Our mobile society exposes all age groups to the risk of crashes, as passengers, as drivers, and as pedestrians. The automobile is essential for the style of life we demand, and yet, motor vehicle crashes remain a major health problem. In contemporary society, automobiles play an indispensable role in transporting people and goods, and yet, the health care cost of motor vehicles is a national financial burden that must and can be reduced. The increasing demand on the highway infrastructure all but negates gains realized from successful initiatives such as increased safety belt usage and reduced drinking and driving. What seems to be missing is objective knowledge of what really happens in a crash. This is

extremely important since despite the large numbers of crashes --no two crashes are the same. Motor vehicle safety is complex. This complexity can be simplified if more crash data was available.

The bottom line is the more information that we have -- the better opportunity to enhance safety.

The National Highway Traffic Safety Administration (NHTSA) has established an Event Data Recorder (EDR) working group made up of government and industry officials to encourage manufacturers to obtain large-scale deployment of crash sensing and recording devices. NHTSA is defining functional and performance requirements for electronic data recorders, understanding present technology, developing a set of data definitions, discussing various uses of the data, and resolving legal and privacy issues.

American's deserve both privacy & safety while traveling on the nation's roadways.

The Need

In 1997, NHTSA, under a joint agreement with the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) and NHTSA, contracted with JPL to: "Evaluate air bag performance, establish the technological potential for improved air bag systems, and identify key expertise and technology within NASA that can potentially contribute significantly to the improved effectiveness of air bags." The JPL Report served as an impetus towards implementing on-board EDRs in vehicles. In the final report of the project, JPL recommended that NHTSA investigate EDRs, stating in recommendation (6): "Study the feasibility of installing and obtaining crash data for safety analyses from crash recorders on vehicles. Crash recorders exist already on some vehicles with electronic air bag sensors, but the OEM's determines the recorded data. These recorders could be the basis for an evolving data-recording capability that could be expanded to serve other purposes, such as emergency rescues, where their information could be combined with occupant smart keys to provide critical crash and personal data to paramedics. The question of data ownership and data protection would have to be resolved, however. Where data ownership concerns arise, consultation with experts in the aviation community regarding the use of aircraft flight recorder is recommended."

Recent emphasis towards incorporating an Event Data Recorder (EDR) in future motor vehicles may serve as the missing link in understanding crash behavior of occupants and vehicles. On-board recording devices will quickly explain what happened, and therefore, enable investigators and the industry to prevent a similar situation from occurring again. Technologies are currently available and the infrastructure exists. But these have not been used to solve the number one safety problem in America – motor- vehicle crashes. EDRs have a great potential to prevent deaths and injuries on the world's highways. With this information it will be possible to measure real life crash pulses experienced by vehicle occupants and additionally, the circumstances prior to and post crash can be better understood. Open access to recorded vehicle information will benefit investigators, manufacturers, and vehicle occupants and greatly improve our highway transportation system.

Call for a Dramatic Breakthrough

According to the National Academy of Engineering, of the top 20 engineering breakthroughs of the 20th century, five were transportation related: the automobile, No.2; the airplane, No.3; the interstate highway system, No.11; space exploration, No.12; and petroleum and gas technologies, No. 17.

Electrification was No.1. All these technical miracles are now last millennium history. Today the challenge lies in combining communication, information, transportation and safety. It can be done, and eventually it will be accomplished. Someday we will all be safer. Perhaps ITTE professionals can accelerate "someday" (and get there sooner) by combining telecommunications and transportation research and development. Lately IEEE experienced a revolution in electronics and information technology. Now is the time to apply these accomplishments and focus on transportation safety.

Let's make the number one engineering breakthrough of the 21st century be "*to create the elusive safety countermeasure that will reduce injuries and deaths on our highways*". *–T.Kowalick*

The Institute of Electrical and Electronics Engineers (IEEE) is positioned to become a major player, specially the Vehicular Technology Society. The mission statement of "helping to advance global prosperity by promoting the engineering process of creating, developing, integrating, sharing, and applying knowledge about electrical and information technologies and sciences for the benefit of humanity and the profession" fits well. Now it is time to act. Perhaps this paper will stimulate further research, debate and development.

Today the challenge lies in combining communication, information, transportation and safety.

Recommendations

1. Involve IEEE in transportation safety issues.

2. Take the initiative in developing products and services that enhance motor vehicle safety.

3. Enter the debate of privacy vs. safety.

4. Conduct conferences and symposiums specific to improving motor vehicle safety.

5. Establish IEEE Standards for Event Data Recorders (EDRs).

Acknowledgements

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